

METABOLIC POTENTIAL AND ACTIVITY IN FLUIDS OF THE COAST RANGE OPHIOLITE MICROBIAL OBSERVATORY, CALIFORNIA, USA

Hoehler T.¹, Som S.^{1,2}, Schrenk M.³, McCollom T.⁴, & Cardace D.⁵

¹ Space Sciences Division, NASA Ames Research Center, USA

² Blue Marble Space Institute of Science, USA

³ Department of Microbiology and Molecular Genetics, Michigan State University, USA

⁴ Laboratory for Atmospheric and Space Physics, University of Colorado Boulder, USA

⁵ Department of Geosciences, University of Rhode Island, USA

Hydrogen, Carbon Monoxide

Metabolic potential and activity associated with hydrogen and carbon monoxide were characterized in fluids sampled from the the Coast Range Ophiolite Microbial Observatory (CROMO). CROMO consists of two clusters of science-dedicated wells drilled to varying depths up to 35m in the actively serpentinizing, Jurassic-age Coast Range Ophiolite of Northern California, along with a suite of pre-existing monitoring wells at the same site. Consistent with the fluid chemistry observed in other serpentinizing systems, CROMO fluids are highly alkaline, with pH up to 12.5, high in methane, with concentrations up 1600 micromolar, and low in dissolved inorganic carbon (DIC), with concentrations of 10's to 100's of micromolar. CROMO is conspicuous for fluid H₂ concentrations that are consistently sub-micromolar, orders of magnitude lower than is typical of other systems. However, higher H₂ concentrations (10's -100's of micromolar) at an earlier stage of fluid chemical evolution are predicted by, or consistent with: thermodynamic models for fluid chemistry based on parent rock composition equivalent to local peridotite and with water:rock ratio constrained by observed pH; the presence of magnetite at several wt% in CROMO drill cores; and concentrations of formate and carbon monoxide that would require elevated H₂ if formed in equilibrium with H₂ and DIC.

Calculated Gibbs energy changes for reaction of H₂ and CO in each of several metabolisms, across the range of fluid composition encompassed by the CROMO wells, range from bioenergetically feasible (capable of driving ATP synthesis) to thermodynamically unfavorable. Active consumption relative to killed controls was observed for both CO and H₂ during incubation of fluids from the pre-existing monitoring wells; in incubations of freshly cored solids, consumption was only observed in one sample set (corresponding to the lowest pH) out of three. The specific metabolisms by which H₂ and CO are consumed remain to be determined.